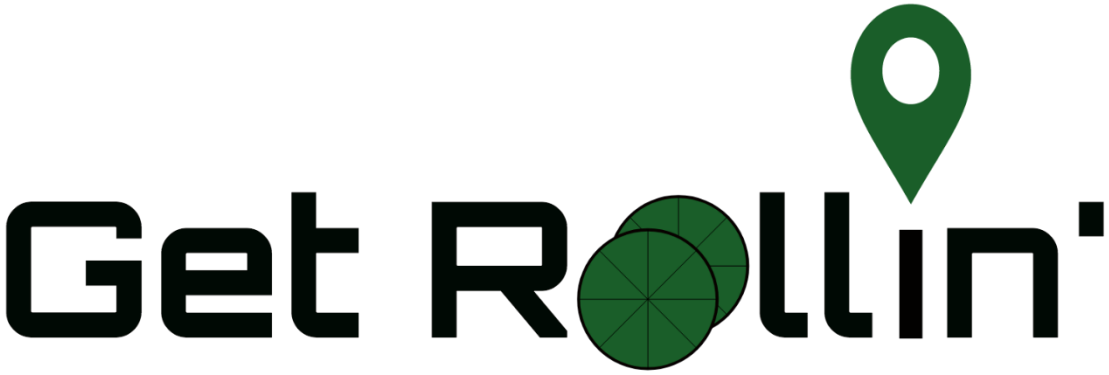

THINK4WARD

Final Design Report

ES 1050 – Introductory Engineering Design and Innovation Studio

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Executive Summary

Assistive technologies generally target fundamental needs within the paraplegic community which make everyday tasks simpler. The goal of this project was to go beyond that and strive towards positive quality-of-life improvements through targeting hobbies and activities. With this in mind, Think4ward dared not to solely target one specific activity that could be done more easily, the team decided to target all activities around the user. This was best done through a mobile application. Through market research it was determined that there exists a void in the amount of awareness about the plethora of accessible activities in a given area. Therefore, this application would target these hobbies. With objectives of incorporating an engaging name, prioritizing simplicity, maximizing result relevancy and incorporating user reviews, Think4ward developed Get Rollin'. This application was built of a platform of Application Programming Interfaces (APIs) including Google Maps, Google Places, and Yelp Fusion. On top of this, Think4ward implemented Google sign-in capabilities, a search bar, reviews, and a result color coordinating system to enhance the user experience. Fueled by extensive research, this application was successful in it's goals of simplicity, aesthetics, overall experience, and maneuverability. Result relevancy was less successful, however it could be improved past the prototyping stage. In conclusion, the engineering design process was followed rigorously in order to give Think4ward the greatest chance at succeeding and solving the problem definition of developing a simple and efficient platform to increase the awareness of paraplegic individuals on the breadth of activities available to them in a close proximity. The intricacies of this process are outlined in the report.

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Introduction

Across the world, many people suffer from paraplegia, which greatly affects their life and its quality. This project aims to counteract this effect and allow individuals with paraplegia to more actively participate in hobbies and activities. By increasing participation in these activities, tremendous social, emotional, and physical benefits will occur. Think4ward wanted to maximize the positive impact that occurred with the design, which led the team to target all accessible activities. This grew into the project goal of maximizing quality of life of the paraplegic community, through increasing awareness of paraplegic individuals to accessible activities near them.

This goal that Think4ward established led to developing an application which locates places where users can find accessible activities along with their ratings. The main features of this application were decided upon to maximize the quality of experience and usefulness of the application. This included a search bar, filters for narrowing results, user reviews and Google sign-in capabilities. Filters allow users to narrow results based on preferences and the type of activity they are looking for. The search bar allows users to find more specific activities in a shorter period of time. Reviews were another important consideration for this application. It was determined that the value added by others who have experienced the activities already, would be significant. With reviews incorporated, users would gain or lose confidence in locations, ultimately leading them to a well-reviewed activity. Lastly, Google sign-in capabilities were implemented in Get Rollin’ to allow the user to save their history and provide reviews for other users to see. This application went through a rigorous design process and comprehensive testing to ensure that the impact was maximized.

This report will outline the life cycle of this application. From initial brainstorming and critical analysis to objectives and constraints, the entire process through which the application was created will be evident. Several principles of engineering, as well as software development were utilized to ensure efficiency and effectiveness of the application in meeting the client's need, as well as the design's objectives and constraints. This report will go over the research, specifications, design and business plan of this project, which will allow it to be scaled worldwide.

Background

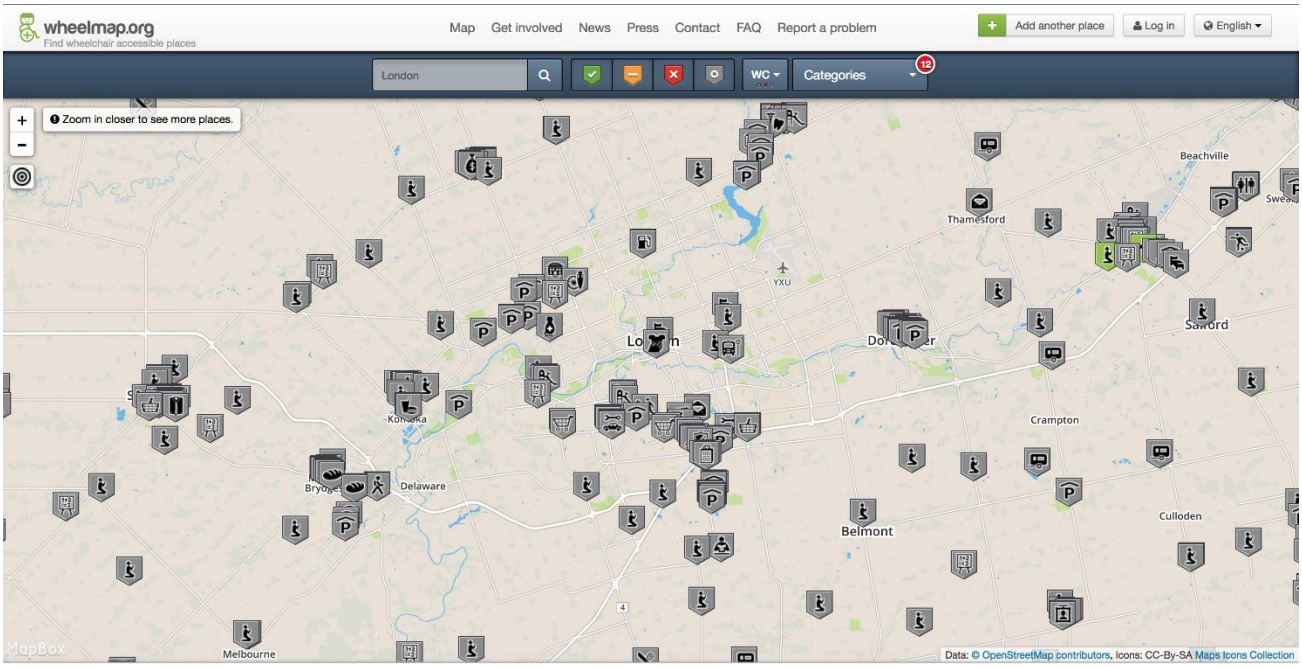
Considering a design involves extensive research to be successful. This design task and final design were not different. Among the many different areas that had potential towards Think4ward's design were the SOTA topics that each team member explored. The topics were mobile applications versus websites, user experience in applications, marketing for applications and RESTful APIs. This research was used to inform all the different facets of the design and was specific enough to pertain to a few main areas. The areas included existing solutions, new technologies, as well as general background research on the need and target for the project.

The goal of this project was to make access to hobbies easier in long-term. Multiple methods to achieve this were researched, for example different online platforms. Websites, and smart phone applications were studied using their pros and cons. With websites, it was found that they were mostly used on computers instead of phones and if used on phones, they were used for short period of time. This went against Think4ward's goal, as the team wanted to give a long-term solution for accessibility. Websites need to be compatible for different types of devices (tablets, phones, laptops, etc.) due to the pixel density and screen size, therefore Think4ward decided not to make one. Applications, on the other hand, can have constraints making it compatible for different kinds of devices. Applications are downloaded once from the store, which is convenient and ideal for long-term use. They also have reviews on the store, which increases the user's confidence before installing and using the application. The team therefore chose a smart phone application as the best approach for this problem, due to ease of use, function, and personalization as compared to the alternatives.

The 'user experience' research centered around ensuring that the interface is maximized for the client. A good user experience is extremely pertinent for three main reasons; client retention, client interaction with the purpose or content of the application and being effective in supplementing the features of the application. User experience can lead to client retention because if the user has a good experience with the application, regardless of the success of the using session, they are much more likely to return. If the using session is satisfactory and the application experience is equally average, the user is likely to stop using it or delete the application all together. Furthermore, the user experience is important as it is the medium through which the client extracts the application's use or purpose. Lastly, the user experience can be created to supplement the application's purpose, meaning it can be used to enhance the effectiveness of the application. These opportunities had great potential when it comes to this design, as Think4ward was trying to maximize the benefit from the application which is to increase the awareness of available opportunities.

When analyzing the user experience of existing solutions, it was apparent that this was a weakness and would be a good area for product differentiation. Wheelmap and AXS map had weak user experiences that did not supplement the content of the application; if anything, the application's purpose was negatively affected by the user experience. A screenshot of Wheelmap's user interface can be seen below. (map, n.d.)

Figure 1: Wheelmap Interface



It is easy to see that this interface is not very attractive or intuitive. This research informed the application's development in terms of ensuring that the data and user experience is strong. The last strong piece of information that resulted from the research on existing solutions was their application's target. These existing solutions targeted a general range of places that were wheelchair accessible. This helped shift the scope of the project towards targeting places to participate in accessible activities.

Another important part of the user experience research was the use of application programming interfaces (APIs). They are used by developers to "piggy-back" off existing libraries of code and data. In the case of this application, the team's research pointed us towards the Google Maps and Places APIs which let us use the basic Google maps interface and build more features off it.

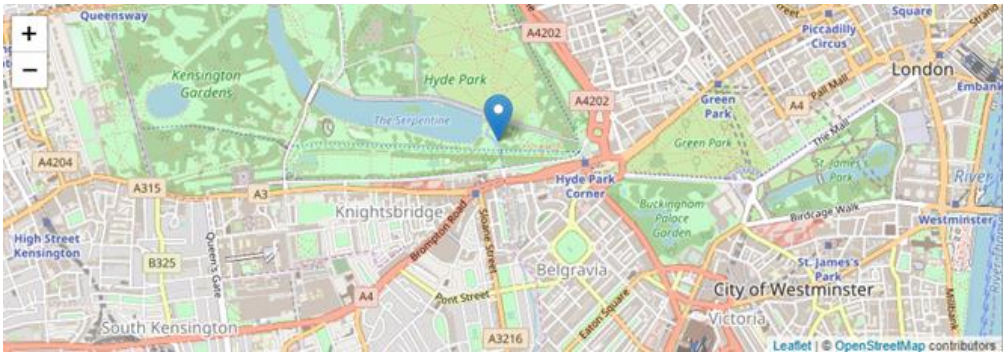
In addition to the importance of user experience and different application platforms, marketing of applications was also researched. The team was determined that most marketing is done through the Play Sore, YouTube, as well as other social media platforms. One study found that only one in four applications are found through the app search. This means that most of the applications are found through

other methods. One of these important methods is search ads such as the Google Universal App campaign. This campaign allows companies to optimize their target market by setting goals and allows them to connect with any of Google's properties such as YouTube, Google Play, Google.com, as well as looking at sites and apps that are in the Google Display Network. It uses performance data that can be analyzed in order to optimize the application target.

The shift of how users are finding their applications has caused many companies to have to rethink their whole marketing strategy. Recreating a marketing plan can be associated with some costs, and this campaign especially, can be very expensive. Since it relies heavily on search results and data analysis, the target market must be well understood in order to target effectively. In this case, the group must consider that the current target market is rather small, and the search results will have to be very specific in order to be an effective marketing strategy.

As referenced previously APIs are a fundamental portion of application programming. A RESTful/Rest API is a service that can be accessed to obtain information. Large corporations, who are capable or obtaining large portions of data usually make it public. The access point between the collected data and the user's application is called an API (Application Programming Interface). When creating an application, often an important aspect is selecting the right API to utilize. The APIs that Think4ward selected to analyze were for the base mapping: Google Maps, Bing Maps and Leaflet. Google Maps is a strong reliable mapping software that is adaptable to android programming. Bing Maps is another strong mapping software offered by Microsoft, that is greatly adaptable to web applications. Finally, Leaflet is a smaller mapping software and is known for high information mapping, however this can be crowded for the user. Think4ward finally decided to use Google Maps as it was minimalistic and greatly adapt to android.

Figure 2: Leaflet Maps



When using APIs in an application it is important to understand the way code runs. Code runs linearly on a "Thread"; threads represent instances of code. When programming applications, much of the

code exists as event calls, that are executed when a certain action is called in the program (i.e., a button is pressed). Since applications are completely dynamic, it is important to keep the code constantly running. A user must be able to interact with an application at any time, therefore an application cannot freeze at any point. Since API calls happen in real time, it can often take a couple seconds to execute. To avoid the freezing of code, a certain type of programming is used, Asynchronous Programming. When programming Asynchronously, a secondary thread is created, branching off the initial thread; this concept is called "Multi-Threading". The second instance continuously runs until a response is sent by the API. This way the response is retrieved by the program and freezing is avoided.

Problem Definition and Project Specifications

Think4ward's problem definition was to develop a simple and efficient platform to increase the awareness of paraplegic individuals on the breadth of activities available to them in a close proximity. This definition came out of market analysis which displayed a huge void in the world of accessible activities. With extensive research and analysis done, it was readily apparent that the largest barrier in participation in activities is the inaccessibility to information. Therefore, if there is a direct relationship between quality-of-life and participation in activities, a large increase in participation due to an increase in accessibility and awareness will lead to a large improvement in quality-of-life. The objectives for the application were to:

1. Have an engaging name
2. Prioritize simplicity
3. Maximize result relevancy
4. Incorporate user reviews

These objectives were chosen in order to strive towards large quality-of-life increases for Think4ward's users. An engaging name was prioritized in order to draw more users to the application and increase the opportunity for them to enjoy their favorite activities. Prioritizing simplicity was important for two reasons; firstly, from the user experience research it was noted that simplicity can enhance the user experience. Secondly, complexity with the software programs makes it more difficult to maintain in the long run, which Think4ward needed to avoid. Result relevancy was paramount as it has the largest impact on the effectiveness of the application at achieving its purpose. Lastly, incorporating user reviews was important to this design in order to help the user better understand the quality of the activities that they are browsing. The constraints for the application were:

1. Lack of Data About Accessible Activities
2. Simplicity/Feature Trade-Off
3. Cost Effective for User/Developer

These constraints focused the design. From the beginning of the design process, it was understood that it would be very difficult finding relevant information in terms of where accessible activities can be found due to the fact that there is a fundamental lack of information in this subject on the internet. This meant that Think4ward's application had to be able to source activities and could not expect good results to be apparent in a single search. The next constraint was important because simplicity was required and therefore the line between this and a number of features needed to be analyzed and properly balanced. Lastly, Think4ward understood that cost was a constraint for both the user and developer, as the application was to be as accessible as possible. Furthermore, there were project constraints in cost which had to be met.

Concept Selection

Think4ward assessed the overall problem definition and began targeting outdoor activities. Paraplegic individuals are not able to partake in many physical activities; Think4ward realized that an apparatus must be designed to solve this issue. Three main concepts were generated and developed: a modified golf club, an aiming assistant for billiards and an activity locating application.
For this concept selection, the following criteria were created:

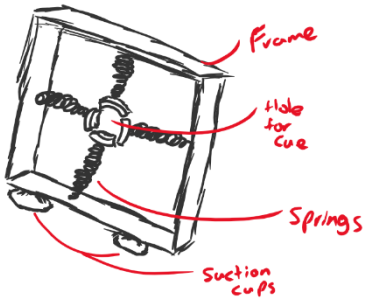
1. Product for a large demographic
2. Easy to use
3. Reusable
4. User-friendly
5. Safe to use

One of the original ideas that arose from an initial brainstorming session was a modified golf club. Golf has previously been targeted in the assistive technology industry, however the golf club specifications have not been directly modified to increase the ability of these individuals to play golf well. There are specific impact conditions that are affected when a swing comes from a low height, at a different angle, and from using only the arms. The three main differences are a large in to out club path, a lower angle of attack, and a decrease in swing speed. Therefore, combatting these issues could be done by increasing the loft of the golf club, increasing the clubface angle, creating a left to right spin bias, and increasing the coefficient of restitution. The issue with this is that their are restrictions to club modifications implemented in the USGA Rules of Golf, however unless the clients are participating in tournaments these rules don't matter hugely. Therefore, making these modifications would allow paraplegic individuals to hit it further, higher and straighter letting them shoot better scores and improving their quality of life. The diagrams below outline the modifications that would be made to a golf club.

Figure 3: Modified Golf Club Diagrams

Think4ward's second idea was to create an apparatus to aid triplegic individuals aim a cue stick. The game of billiards/pool requires an individual to utilize both hands to aim a cue stick, this stick is used to hit the cue ball. Both hands are used when holding the cue stick as one is used to aim and the other to apply a force. However, this is fundamentally impossible to mimic by a triplegic individual. Therefore, Think4ward decided to design an apparatus that holds the cue stick and can be attached to the pool table. The design would be able to allow users to aim the cue stick, would be removable and re-attachable and adjusted for the increase in cross sectional area associated with pushing the stick. The resultant design allows triplegic individuals to successfully aim the cue stick, overall increasing the quality of life. A sketch of this design is below.

Figure 4: Billiard Aim Aid Sketch



The final brainstormed design exploited the fact that many assistive technologies are already in the market. Therefore, accommodated activities are already available to paraplegic individuals. If these technologies are available in facilities, the problem becomes the accessibility of these locations. Many paraplegic individuals do not have the tenacity to continuously search for these locations. Therefore, Think4ward began designing an application that utilized review analysis to discover these locations. Furthermore, the use of an application was chosen to allow for the ease of accessibility off a user's phone. Cumulatively, the application would close the accessibility gap between accommodated and

unaccommodated activates as it would provide paraplegic individuals with the tools to discover these locations. With more and more paraplegic individuals partaking in physical activates, fundamentally the quality of life is improved.

The three concepts were mapped in a Go/No-Go chart and a decision matrix so that Think4ward could decide which design to go forth with. With the design objectives in mind the team realized that the design most equip with their wants was the Mobile Application.

Figure 5: Go/No-Go Chart

	Large Target Market	Ease of Use	Reusable	Safe	Cheap	Size Constraint Met	Weight Constraint Met	Go/No Go
Golf Club	No	Maybe	Go	Go	No	No	No	No
Billiards Aim Aid	Maybe	Maybe	Go	May be	Maybe	Go	Maybe	No
Mobile Application	Go	Maybe	Go	Go	Go	Go	Go	Go

Figure 6: Decision Matrix

						Total
Weight Distribution	7	3	5	3	2	20
Weight Percentage	35%	15%	25%	15%	10%	100%
Option	Large Target Market	Reusability	Ease of Use	Safe	Cost	Score
Golf Club	-1	1	1	0	-1	-0.05
Billiard Aim Aid	0	1	1	0	0	0.40
Mobile Application	1	1	1	1	1	1.00

Design Principles, Engineering Iteration and Evaluation

Scientific Principles

The first principle that educated Think4ward's design was the Keep It Simple, Stupid (KISS) principle. This was used because the Team wanted to ensure that the application was simple from the user perspective, meaning that all features were useful and the screen is not cluttered. Furthermore, this principle informed the development stages because the more simple the software, the easier it would be to maintain and debug it.

The second principle Think4ward utilized within the design was Multi-Threading. Multi-Threading is a way of programming that utilizes Asynchronous calls to obtain data. Utilized mostly in API calls, Asynchronous calls are branches of code that separate themselves onto a secondary thread/instance. Having these API calls on a secondary thread ensures that the application is interactable while the API computation is running. This allowed the application to be tested throughout its development and allowed for iterations to be made quickly and effectively.

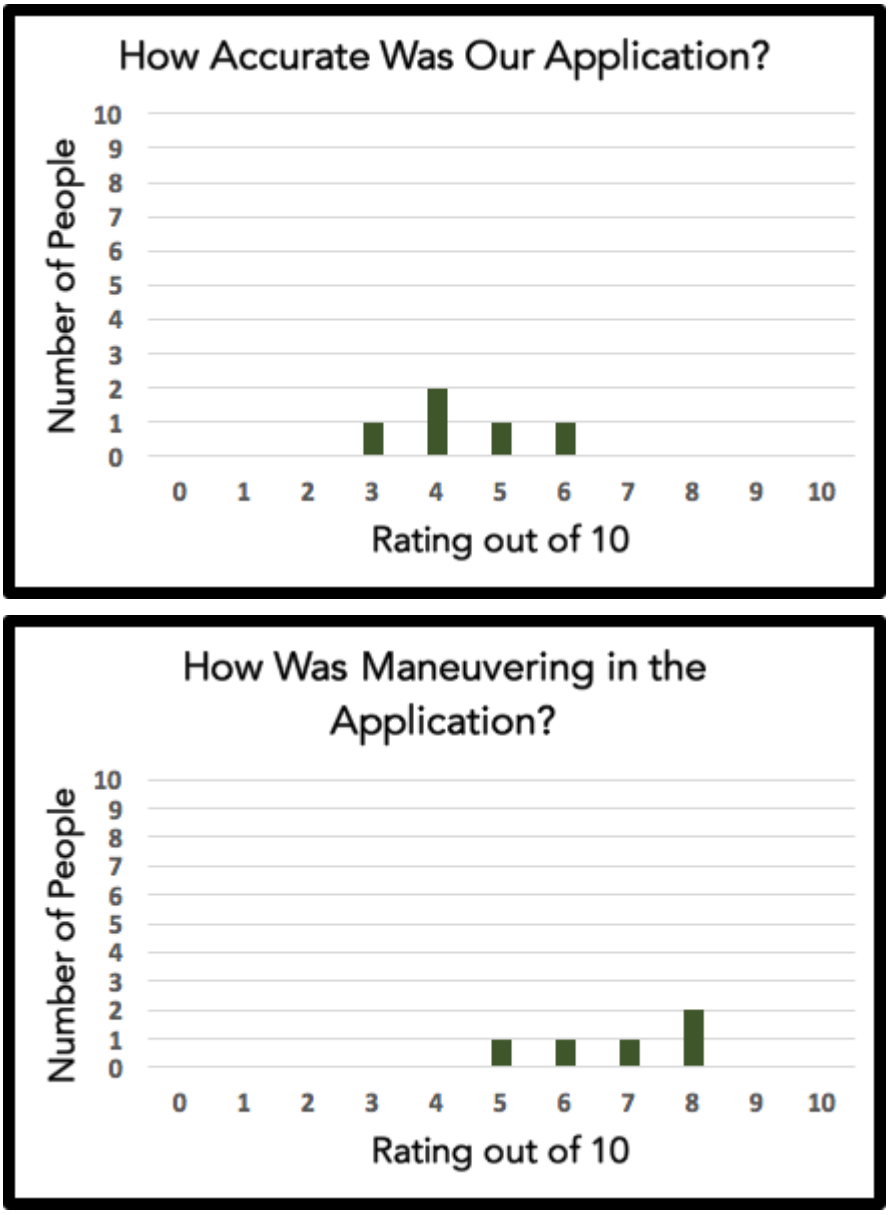
Initial Description of the Prototype

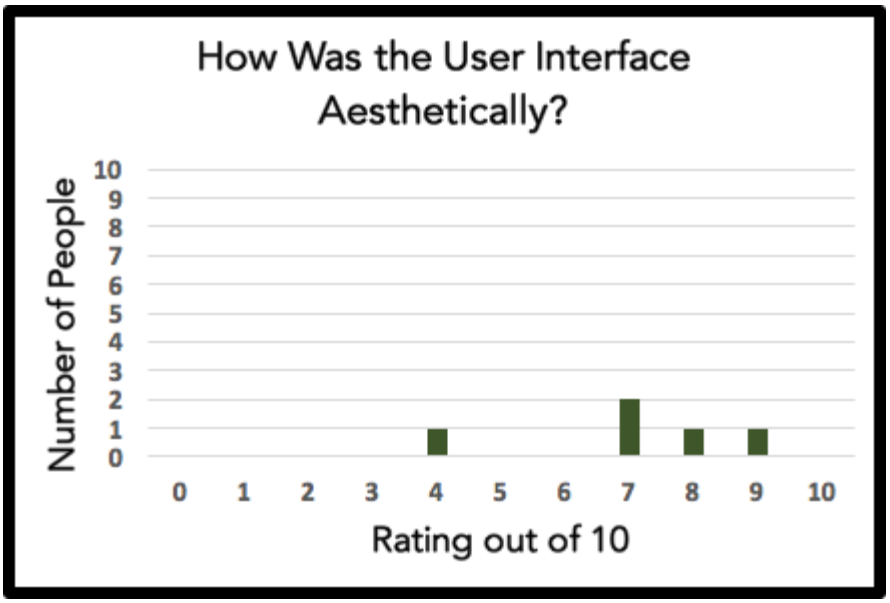
Initially the prototype for the design of the application included a login page, map, filter button, and menu. The login page would have the logo of the application, and two text boxes, one for the email and the other for the password. The map would have pins red and green, green representing the accessible places for the hobby chosen. The specific hobby the user is looking for could be found in the filters, which would already be provided. The menu would give the profile of the user, option to personalize the application, or to log out.

Initial Testing

The initial testing was based on our main objectives towards the application, accuracy of the locations, maneuvering through the application and the aesthetics. Five family and friends were contacted twice to test the application, once for the initial testing and the other for the final one. Think4ward recognized that a large test sample was not required due to the simplicity of the features being tested. It was important to note that despite the small testing population, all testing data was majorly favored towards a certain average. The accuracy of the application was mid-low, the maneuvering was mid, and the aesthetics were mid-high according to the users as shown below.

Figure 7-9: Initial Testing Results





Iterations and Analysis

After these results, the team decided to add three things to the application:

1. Searching Feature
    - Allowing the user to filter results based off key terms
2. Google Profiles
    - Connecting the accounts to google allows for ease of access
3. Reviews/ Rating
    - Integrated relevant reviews to allow the user to understand services offered at locations
    - Clicking on the pins would open the review section for the place; this would also let the user add reviews to specific place to help others in the future

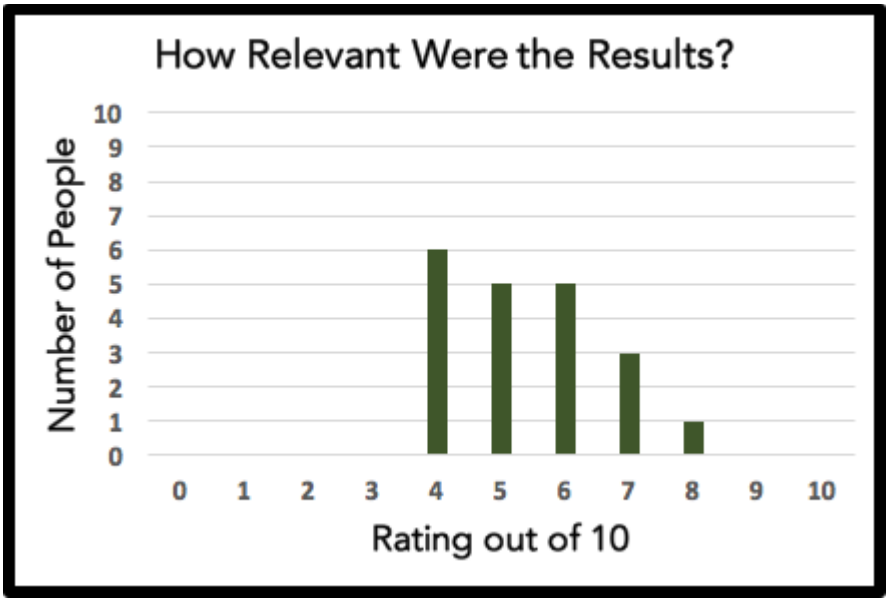
To improve the user interface more, XML Development was chosen as it has a broad spectrum of things that can be used. To enhance the user and development experience, these elements were also added.

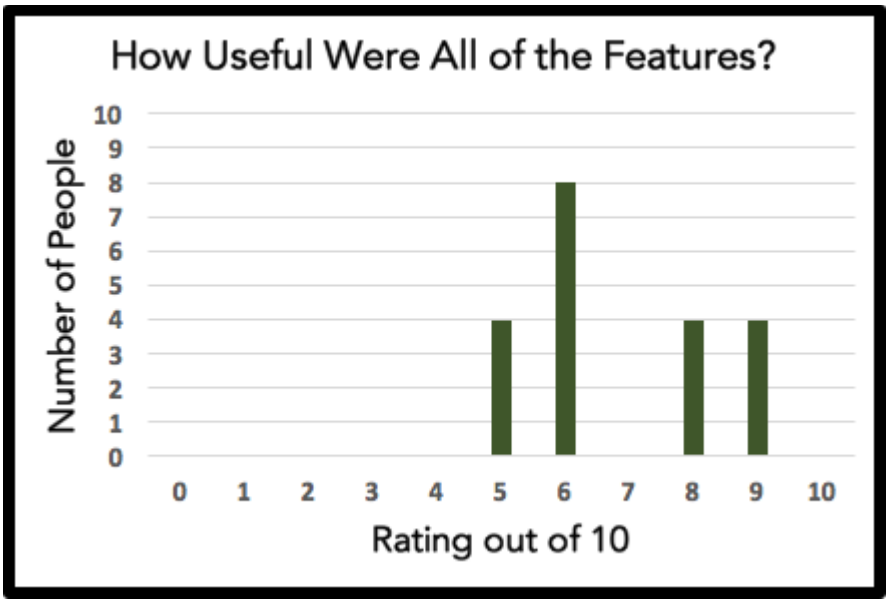
1. Increased Testing Ability
    - Android Studio Emulator
2. Increased Concept Feasibility Testing
    - Storyboarding on android studio

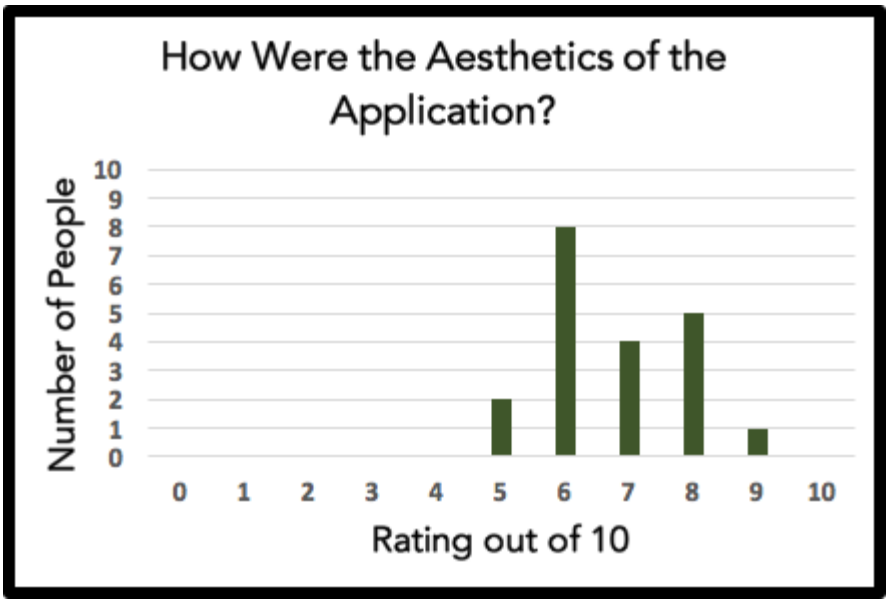
Final Testing

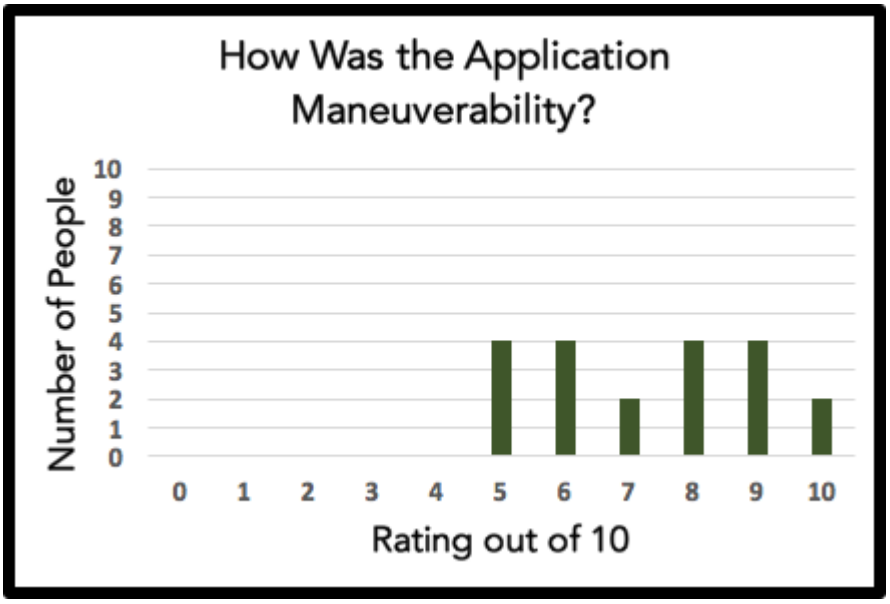
After the components were added and the design was finalized, the previous testers and 15 more used the applications and the reviews were much better than the previous time as shown below. The team was satisfied with these results as a whole for the final prototype.

Figure 10-13 Final Testing Results









Description of Final Design

The following were the outlined application specifications:

1. Location
2. Developed for Android
3. Searching Capabilities
4. Attractive User Interface
5. Incorporate Activity Filters

6. Utilize Google and Yelp APIs
7. Sign-In with Google

The final design is an application with the potential for large scale positive impacts amongst the paraplegic community. The application aided paraplegic individuals in locating accommodated activities within their local area. Furthermore, to increase reliability the application utilized a review analysis algorithm which selected the accommodated facilities; this way a user could read the related review and determine whether the location suited their needs.

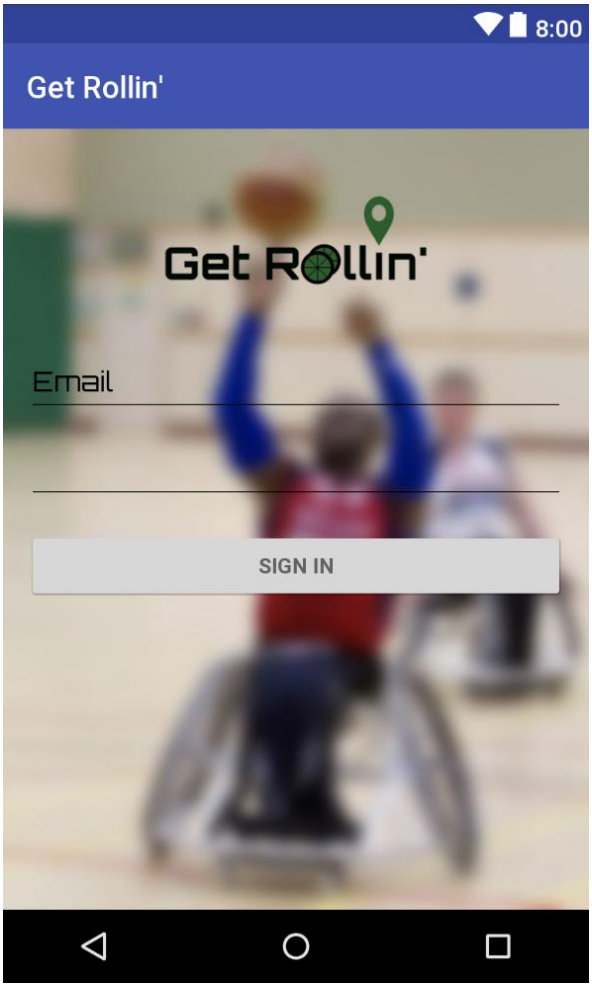
Think4ward's core focus was to find a balance between features and design; there were to be no useless features and a minimalistic design. The final application depicted the minimalist design as the user only had access to 3 main features: Search, Read Reviews and Write Reviews. The search feature acted as a simple filter tool that allowed users to search for specific activates. Upon searching the user was met with a map full of markers, some markers were 'greenlit', these greenlit markers represented the availability of accommodated activities. The program determined whether a marker was to be greenlit or not by reading the reviews associated with the location.

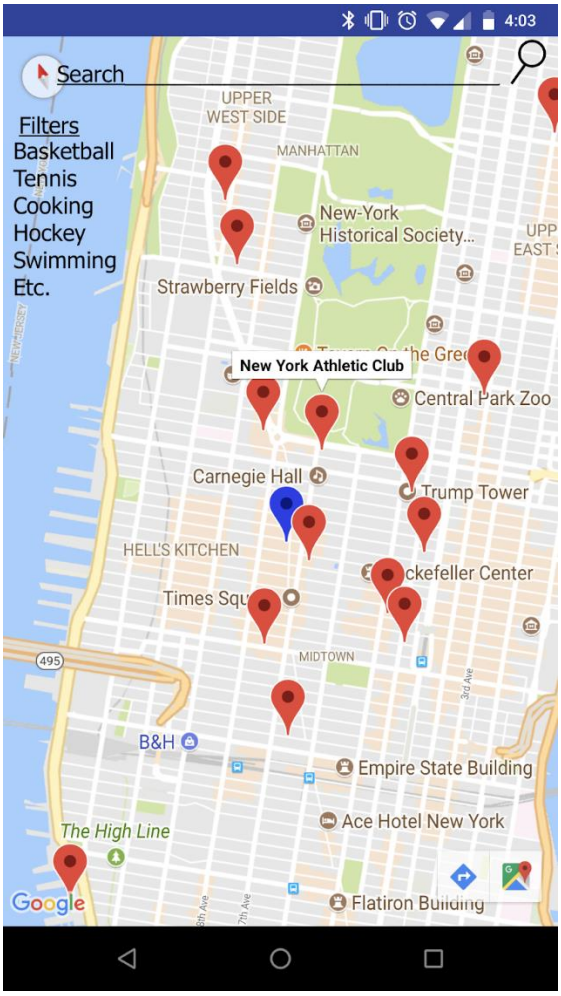
From the bottom up, the application was built with a strong user experience in mind, which justifies the use of four APIs. Google Maps, Google Natural Language Translator, Google Places, and Yelp Fusion. These APIs powered the application and allowed for an interface and platform on which the application was constructed. Visually the application resembled Google maps with a few additional features. The backend of the application utilized the remaining APIs. When a user searched a phrase the application would conduct a yelp search to find locations, these locations would be plotted onto the google map as markers. Next the program continued to analyze reviews provided through the Yelp and Google places API. The reviews would be analyzed by searching them for a key word, in this case "wheelchair". The program took the keyword and obtained an intent from the Google Natural Translator API, the intent was used to search for similar phrases within each review. If the program encountered a reference within a review, it greenlit the location. This was repeated with every marker to obtain all greenlit locations.

After a user was shown greenlit locations, they were met with the option to read the reviews associated with the location. The reading of reviews allowed the user to asses whether a location provided the intended activity. After a user visited a location they had the option to write a review on the location, these reviews would be posted to Google places. As the amount of reviews on a location increases, so does the ability for the application to extract information, this makes Get Rollin' a highly scalable application.

Fundamentally, Get Rollin' is an application that allows for the ease of accessibility of accommodated activities for paraplegic individuals. This way paraplegic individuals can locate and partake in more physical activities. Conclusively the ability for paraplegic individuals to easily locate facilities that offer assistive technologies improves the quality of life. Screenshots of our application can be seen below.

Figures 14-15: Application Screenshots

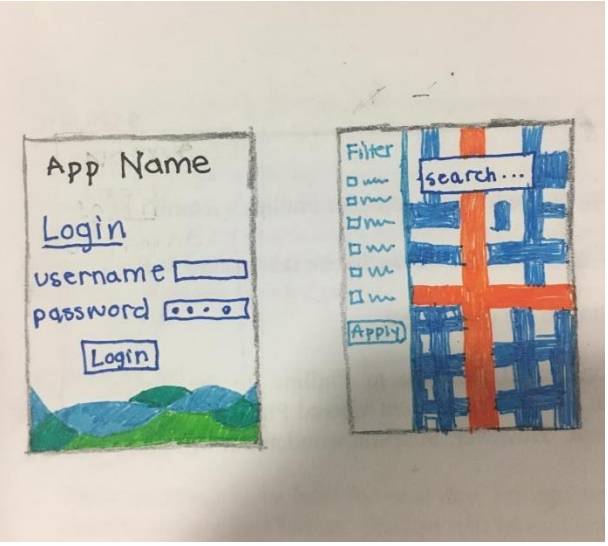




Design Drawings

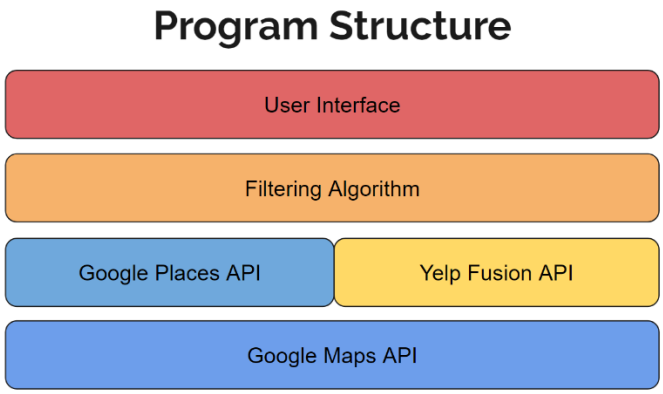
Initial design of the application was drawn on paper, it included the basic idea including the login and the main page. The login page inluded text fields to input user name and password, with the logo of the app and a nice background to make it asthetically pleasing. The main page of the app included filters for the hobbies, a search bar, and an interactive map background.

Figure 16: Design Drawing 1



The final program structure can be depicted effectively by the diagram below. The base of the program relied on the Google Maps API, using the maps Think4ward was able to show the location of the user along with local activities. The next layer consisted of the Google Places and Yelp Fusion APIs, these APIs were used to retrieve reviews to be filter and assessed. The filtering layer consisted of the Natural Language Translation API that assessed whether a location offered an accommodated activity. Finally, the User Interface consisted of any design elements (buttons, search bars, ect) that were to be shown to the user.

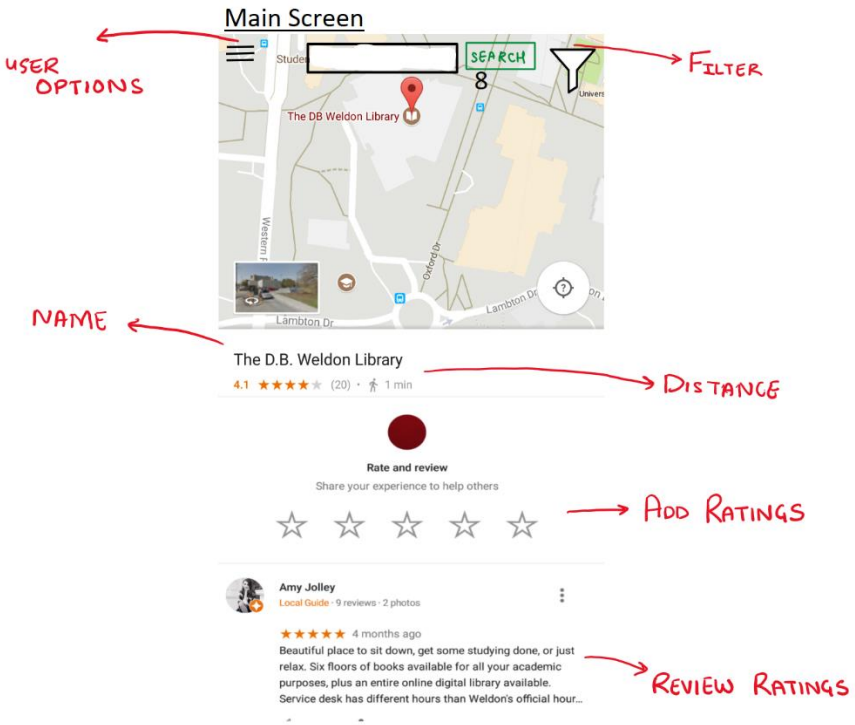
Figure 17: Program Structure



The drawing below is the final design of the main screen, this drawing shows the user options on the top left corner. Clinking on the user options opens up then menu which will include the user profile and the option to logout of the application. On the top center there is a search bar, which lets the user enter the location name or the hobby they are trying to find. The filter button on the top right corner lets the user filter the results from the search. In the middle of the screen, the pin shows the places from the search.

When the pin is clicked for the locations, the user review section shows up as shown on the second half of the screen. The user can read the reviews and add them by connecting their Get Rollin' to google accounts to help other users.

Figure 18: Design Drawing 2



These features shown in the drawings will help build a better community for the users and give them a chance to help each other out using this platform.

Description of Prototypes

The final prototype was made after careful consideration and input from users when testing then application,

- Initial prototype design consisted of the following features:
    - A filter button to filter the types of activities
    - A search button to search terms
- It was essential to balance features and design
    - The application could not be too crowded with useless features
    - The application must have a simple and appealing design
- Things we changed from Prototype 1 to Prototype 2:
    - The inclusion of a Review reading feature

        - This feature of important as it allowed users to read the reviews on a location instead of visiting it blind sided
- Main problem with Prototype 2:
    - It was evident that the application was fairly crowded
    - This meant we had to remove some features
    - A simplistic design with hidden features was desired
        - Hidden features: features that cannot be seen when opening the application, however they can be "revealed" with the selection of a function/button
- Prototype 2 to Final Design:
    - The combination of the filter feature and search bar
    - The application would have a single search bar that acted as a filter for all locations
    - This way the user was not met by all available locations at once and had the ability to search for their specific activity
    - The final feature was the inclusion of writing reviews
    - The reviews were to be posted onto google places

The final prototype had fairly good reviews from the testing done and the prototype was chosen for the application.

Innovations and Creativity

The fundamental point of innovation lies within the algorithm. The main algorithm within the application sorted locations based off if they offered accommodated activities or not. The program completed the sorting based off the reviews. The algorithm made use of 3 APIs, Rest APIs are used within server to client data exchange, in this case Google Places, Yelp Fusion and Google Natural Language Translator were used.

The user would search a term, the phrase would be searched in the yelp directory for locations. The locations would be pulled for Yelp and an accumulation of reviews from Yelp and Google Places would be prepared for sorting. The reviews for each location would be tested for an intent and phrase, in this case "paraplegic activities" and "wheelchair" respectively. The intent and phrase would be tested within each review and upon location within a review, the location would become 'greenlit'. The main chunk of innovation for this algorithm existed within the natural language translation. Natural Language Translation is a way for a computer to extract an intent from a phrase and extrapolate a meaning out a sentence.

Since the application utilized reviews to assess a location, this meant that there is a possibility of infinite scalability. As more users utilized the application, each location would increase in amount of

reviews. As the amount of reviews increases per location, so does the general picture of what is offered at the location. This meant that when more users begin using the application, each search result will become more relevant than the last, fundamentally improving scalability.

Business Plan

When an idea is developed for a project it is always important to determine the financial feasibility of the project. In particular, it is crucial to look at the long-term goals and if they are feasible. For this project, the team is considering the costs of launching the app and bringing it to the public. In the short term, the costs for this idea remain relatively low, however as the app expands and grows, the costs can increase significantly. This can cause the team to have to put a lot of thought and planning into strategic advertising and costs associated and determining what parts of the project are feasible with the current budget and which ones are not.

In terms of the business side of the app, it is important to consider that in order to launch the app there are many costs associated with this. For one, in order to be able to launch the app, a onetime fee of 25 USD must be paid to the google play store in order to become a google developer. As well, fees must be paid to market the app as well as certain fees must be paid to use API's. However, since the aim of this project is to give back to the community, it will be important to try to limit the costs associated with building and launching this app and for this reason, API's will be used only when they are free.

When developing the app, open source API's were used as they are readily accessible to the public and can be used for free if they are used under the free limit capacity. The google maps android API has an unlimited free storage so it can be used as much as is needed ("Pricing and Plans | Google Maps APIs Pricing and Plans | Google Developers", 2018). The google places android API has a maximum use of 150,000 requests per day ("Pricing and Plans | Google Maps APIs Pricing and Plans | Google Developers", 2018). The yelp fusion API was also used, and it has a maximum number of 5,000 API calls per day ("Rate Limiting - Yelp Fusion", 2018).

After considering the API's that were used in the development of the app, it was seen that two of them had a capacity on how many requests and calls could be made in a day for free. This is important to consider because it puts a cap on how many people can use the app while ensuring that there are no costs associated with API's. After doing a thorough analysis of the capacities, it was seen that the Yelp fusion API was the most restrictive in terms of number of users that could access the app and use it per day. In fact, it was seen that the maximum number of users that could use the app in a day was about 500. (It was assumed that the average user would make ten calls to the yelp fusion API, eight requests to the google places API, and 25 requests to the google maps API per day) This proves to be a small number when considering the potential, the app has to be expanded to new areas. However, at the present moment,

assuming the app is launched to the community and targeted to a specific community, 500 users per day seems to be a realistic number for the launch of the app.

In terms of marketing of the app, many ideas were generated. It was decided that the app would be marketed in local centers in the community and organizations that would benefit from this app or have potential users that go there. This would be a low-cost way to advertise and has the potential to target the right people. The cost of printing a colored poster paper is $0.39 per piece and ordering 500 copies would cost $169 dollars. Since this app is to help paraplegic individuals in the community and the app will be provided free of charge, it will be important to keep all costs low and consider the potential target market. While the app does have the potential to grow and expand to other cities, this group has decided that for the present moment it would like to target the immediate community of London and surrounding areas, and when the app has grown its user base enough then the growth of the app will be considered. So in this aspects, Google's Universal App campaign could be used to market in the near future but will not be used in the present since the costs associated with this advertising method are so high and do not necessarily provide good conversion rates. (Average industry standards show the average cost of a campaign like this would be around $2.69 dollars per search and $0.63 dollars per display). Since the group has a $400 dollar budget, this method would quickly blow through this money and would not be an effective way to market in the short term.

While the group has determined that the google play store is a good place to launch the app, it was also decided that after 1-2 years the app could also be expanded to the apple app store. This would generate more costs that need to be covered but would in fact bring no users to the app that cold find this app very beneficial. The costs associated with this venture would be approximately $99 per year.

Conclusion

In conclusion, this group believes that this design project goal was achieved. After completing the design process and going through iterations, a fortified foundation for the app was created. The report outlined some of these iterations and the design process that the group went through in order to come up with the final design.

When the problem was first introduced to the group, a list of constraints was developed in order to ensure that ideas that were created would have a basis to follow. After brainstorming, concepts were generated that fell within the design constraints. The main ideas were to create an application that helps paraplegic individuals to find activities and hobbies near them, to create an aid to help aim when playing billiards, or an adapted golf club. Once these ideas were developed they were evaluated using the decision matrix and go/no go and this led to the choosing of the application.

Once the application idea was developed, some sketches of potential user interfaces were drawn. This led to the design portion of the application being created using Android Studio. As well, since the goals were established for the application, and the programming took place. This programming part went through a couple iterations. The app started as a filtering algorithm, then the Google Places and Yelp Fusion API's were added, followed by the Google Maps API.

After the application was developed the team focused on the testing portion. After testing with friends and family was done, the results were used to improve the app and develop its user interface. The feedback showed that work had to be done on the location accuracy of the results that were achieved, and so some work was done on the app to try to improve this.

Through this project, a lot of valuable lessons were learned as well as important skills. This project allowed the team to encompass the whole design process and to improve their knowledge in doing so. This project led to greater communication in the group, as each part of the app had to be coordinated and deliberated. This gave the team a new appreciation for teamwork and allowed them to understand that groupwork in the engineering profession is very important. In addition, the team learned the importance of communication through the many presentations that were given, the design showcase, and the reports that were required. This allowed them to understand that without proper communication skills it is impossible to engage the audience or allow them to understand what is being presented. These skills prove to be very valuable in the engineering world in order to relay the general message to the judges or potential clients.

The group acknowledges that although a base model for the app is developed, it needs further development. For future design recommendations, it would be important to improve the accuracy of the results that are seen in the app. By developing this application with these main redeeming features, Think4ward believe that this solution can have an extremely positive effect on the quality of life of paraplegic individuals who use the application. The quality of the results will increase as more and more users begin to use the application, and with a bit of momentum, our app will truly Get Rollin’.

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Appendices

Appendix I – Grade Distribution Form

Grade Distribution Form

Design Team Identification:

Studio Number: 12 Studio Instructor: John Dickinson

Team Number: 04 Draft: __ Final: ✓ Date: April 6

The undersigned agree to the following distribution of our Team Grade:

Design Team Member Name (please print): Ibtesam Mahmood

Percentage of Team Member Grade: 25.5%.

Signature of Design Team Member: Ibtesam

Design Team Member Name (please print): Holly Greer

Percentage of Team Member Grade: 23.5

Signature of Design Team Member: Holly Greer

Design Team Member Name (please print): Yusra Irfan

Percentage of Team Member Grade: 25.5%.

Signature of Design Team Member: Yusra

Design Team Member Name (please print): Tom Reeve

Percentage of Team Member Grade: 25.5%.

Signature of Design Team Member: Reeve

Design Team Member Name (please print): _____

Percentage of Team Member Grade: _____

Signature of Design Team Member: _____

As the Studio Instructor for this team, I approve the Grade Distribution above.

Signature of Studio Instructor: _____

Date: _____